

CLAIMS OF THE INVENTION

I CLAIM:

1. A method for creating of laser-induced damage images with reduced
5 sharp star structure comprising:

production of the special transparent material by introducing special kinds of
impurities;

generating laser radiation and focusing it at predetermined points of said material
so that the focal spot area contains at least one said impurity and laser energy exceeds the
10 damage threshold of said material with said impurities at said focal area by a negligible
amount.

2. The method in accordance with Claim 1 wherein said impurities are
determined so that the damage threshold of said material is decreased but said transparent
material keeps its perfect transparent properties.

3. The method in accordance with Claim 1 wherein the size of the impurities
is determined so that, on the one hand, the material keeps its perfect transparent
properties and on the other hand, the impurities give high effect of damage threshold
reduction.

4. The method in accordance with Claim 1 wherein the concentration of said
20 impurities and their distribution inside said material are determined so that a focal spot
area of said laser radiation contains at least one impurity with high probability.

5. The method in accordance with Claim 1 wherein the materials containing
said impurities undergo thermal treatment at the such conditions (at high temperature and
in an oxygen atmosphere), in which the thermal treatment results in damage threshold
25 reduction.

6. The method in accordance with Claim 1 wherein the size of said focal spot is determined so that said laser-induced damage of said transparent material has desirable extent.

7. The method in accordance with Claim 1 wherein colored laser-induced damage images are produced inside said transparent materials containing color impurities, which are invisible before laser interaction, but after laser breakdown become obvious.

8. A method for production of laser-induced damage images with reduced sharp star structure comprising:

generating the first kind of laser radiation heating a material area at a point, where breakdown should be produced, to the vitrify temperature;

generating and focusing the second kind of laser radiation at said point so that the energy of the laser radiation exceeds the breakdown threshold of said material at said vitrify temperature by a negligible amount;

migrating the focal spots of said first and said second radiations during image production so that the positional relationship of said spots is not modified.

9. The method in accordance with Claim 8 wherein the size of said material area, which should be heated to said vitrifying temperature in order that to produce a laser-induced damage of desirable size, is determined.

10. The method in accordance with Claim 8 wherein the optimal wavelength of said first kind of laser radiation is determined so that the essential material area of the predefined points at the desirable depth should be heated to said vitrifying temperature by minimal laser energy.

11. The method in accordance with Claim 8 wherein the optimal pulse width of said first kind of laser radiation is determined so that using smaller energy of said laser radiation it is possible to heat the said material area to said vitrifying temperature and to make sure the desirable speed of creation laser-induced damages.

12. The method in accordance with Claim 8 wherein the laser beam of the said energy, said wavelength and said pulse width is generated by said first kind of laser and is periodically focused at the points of said transparent material heating said material areas to said vitrifying temperature.

5 13. The method in accordance with Claim 8 wherein the optimal focal spot size of said second kind of laser radiation is determined so that for the predetermined size of the heating area, desirable damage can be produced by a laser energy exceeding the damage threshold (breakdown threshold) by a negligible account.

10 14. The method in accordance with Claim 8 wherein said second kind of laser generates radiation, which is directed at the transparent material and focused at the point of heated area so that its laser energy exceeds said damage threshold at said area by a negligible account.

15 15. An apparatus for producing high quality laser-induced images inside optically transparent materials by using two lasers comprising:

the first laser generating radiation for heating an area of said transparent material to the vitrifying temperature;

the second laser generating radiation for creation of breakdown at a point of said material area;

20 the means for combining said first and second laser radiations, directing and focusing said radiations at said area of said transparent material;

the means for displacement of focal spots of both said radiations inside said transparent material during creating laser-induced damage images so that positional relationship of said focal spots is not modified.